Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Previously Presented) A method for determining the location of an alignment mark on a stage, the method comprising:

measuring a location, x_1, of a stage along a first measurement axis using an interferometer;

measuring a location, x_2, of the stage along a second measurement axis substantially parallel to the first measurement axis; and

determining a location of the alignment mark along a third axis substantially parallel to the first measurement axis based on x_1, x_2, and a correction term, ψ_3,

wherein the interferometer comprises interferometer optics configured to direct a measurement beam to reflect from a mirror where the interferometer optics or the mirror are attached to the stage, and ψ_3 is calculated from predetermined information comprising information characterizing imperfections in the interferometer optics.

2. (Original) The method of claim 1, wherein x_1 and x_2 correspond to the location of the mirror at the first and second measurement axes, respectively.

3. (Previously Presented) The method of claim 1, wherein x_2 is measured using a second interferometer comprising interferometer optics.

4. (Previously Presented) The method of claim 3, wherein the predetermined information comprises information characterizing imperfections in the optics of the second interferometer.

5. (Original) The method of claim 1, wherein the correction term, ψ_3, comprises a contribution related to an integral transform of X_2 and X_1 which correspond to x_2 and x_1 monitored while scanning the stage in a direction substantially orthogonal to the first and second measurement axes.

6. (Original) The method of claim 5, wherein the integral transform is a Fourier transform.

7. (Original) The method of claim 5, wherein contributions to ψ_3 from different spatial frequency components of X_1 and X_2 are weighted to increase the sensitivity of ψ_3 to spatial frequency components near K_d and harmonics of K_d, wherein K_d corresponds to the $2\pi/d_1$ where d_1 is a separation between the first and second measurement axes.

8. (Original) The method of claim 1, wherein the alignment mark location is related to a location, x_3, on the third axis given by

$$x_3 = (1-\gamma)x_1 + \gamma x_2 + d_2\vartheta - \psi_3 ,$$

wherein γ is related to a position of a measurement axis relative to the first axis, the third axis and the measurement axis are separated by a distance d_2, and ϑ is related to an orientation angle of the stage with respect to the measurement axis.

9. (Original) The method of claim 8, wherein the first axis and the second axis are separated by a distance d_1 and the first axis and measurement axis are separated by a distance γd_1.

10. (Original) The method of claim 1, further comprising interferometrically monitoring the location of the stage along a y-axis substantially orthogonal to the first measurement axis.

11. (Original) The method of claim 1, wherein the measurement beam reflects from the mirror more than once.

12. (Original) The method of claim 1, wherein the predetermined information further comprises information characterizing surface variations of the mirror.

13. (Original) The method of claim 12, wherein the information characterizing surface variations of the mirror comprises information characterizing surface variations of the mirror for different spatial frequencies, wherein contributions to the correction term from different spatial frequencies are weighted differently.

14. (Original) The method of claim 1, wherein the correction term, ψ_3, comprises a contribution related to an integral transform of $X_2 - X_1$, wherein X_2 and X_1 correspond to x_2 and x_1 monitored while scanning the stage in a direction substantially orthogonal to the first and second measurement axes.

15. (Original) The method of claim 1, wherein the correction term, ψ_3, comprises a contribution related to an integral transform of $X_2 + X_1$, wherein X_2 and X_1 correspond to x_2 and x_1 monitored while scanning the stage in a direction substantially orthogonal to the first and second measurement axes.

16. (Previously Presented) The method of claim 1, wherein the imperfections in the interferometer optics cause an interferometric phase measured using the interferometer to vary non-periodically and non-linearly as a function of a relative position of the mirror along the first measurement axis.

17. (Previously Presented) A method, comprising:

determining a correction term related to imperfections in interferometer optics of a first interferometer in an interferometry system from measurements of first and second degrees of freedom of a measurement object with the interferometry system, where the interferometer optics are configured to direct a beam to reflect from the measurement object; and

correcting subsequent measurements of a third degree of freedom of the measurement object made using the interferometry system based on the correction term.

18. (Original) The method of claim 17, wherein the first and second degrees of freedom comprise positions of the measurement object relative to first and second axes of the interferometry system, respectively.

19. (Original) The method of claim 18, wherein the first axis is substantially parallel to the second axis.

20. (Original) The method of claim 19, wherein the third degree of freedom comprises a position of the measurement object relative to a third axis substantially parallel to the first and second axes.

21. (Original) The method of claim 20, wherein the second axis is located between the first and third axes.

22. (Original) The method of claim 17, wherein the measurement object comprises a plane mirror.

23. (Original) The method of claim 22, wherein the correction term further comprises information related to surface variations of the plane mirror.

24. (Original) The method of claim 23, wherein the information related to surface variations of the mirror comprises information characterizing surface variations of the mirror for different spatial frequencies, wherein contributions to the correction term from different spatial frequencies are weighted differently.

25. (Previously Presented) The method of claim 17, wherein the interferometry system comprises a second interferometer which during operation-monitors the second degree of freedom, wherein the correction term comprises information related to imperfections in interferometer optics of the second interferometer.

26. (Previously Presented) The method of claim 17, wherein the imperfections comprise bulk imperfections.

27. (Previously Presented) The method of claim 17, wherein the imperfections comprises surface imperfections.

28. (Previously Presented) The method of claim 17, wherein the imperfections in the interferometer optics result in an interferometric phase measured by the interferometry system that varies non-periodically and non-linearly as a function of a relative position of the measurement object along one of the first and second degrees of freedom.

29. (Previously Presented) The method of claim 17, wherein determining the correction term comprises determining a sum or difference of the monitored degrees of freedom where the contribution to the sum or difference from different spatial frequencies are weighted differently.

30. (Previously Presented) A method comprising:

scanning a mirror surface relative to a pair of substantially parallel measurement axes of an interferometry system for a plurality of scan paths of different relative positions of the mirror

surface along the measurement axes, the interferometry system comprising an interferometer including interferometer optics configured to direct a beam to reflect from the mirror;

monitoring locations X_1 and X_2 of the mirror surface relative to the interferometric measurement axes with the interferometry system during the scanning;

determining a profile of the mirror surface for each of the scan paths based on the monitored locations; and

determining a correction term related to imperfections in the interferometer optics based on variations between the mirror profiles.

31. (Original) The method of claim 30, wherein determining the mirror profiles comprises determining an average slope of the mirror surface from X_1 and X_2 for a plurality of locations on the mirror surface for each of the scan paths.

32. (Original) The method of claim 31, wherein determining the mirror profile further comprises determining a fit to the average slope of the mirror surface for the plurality of locations.

33. (Original) The method of claim 32, wherein determining the mirror profile further comprises determining variations of the average slope from the fit.

34. (Original) The method of claim 31, wherein determining the correction term comprises performing an integral transform of the average slope of the mirror surface for the plurality of locations on the mirror surface.

35. (Original) The method of claim 34, wherein the integral transform provides information related to contributions to mirror surface variations from different spatial frequencies, and determining the correction term comprises weighting the contribution some

spatial frequencies to the correction term differently than the contribution from other spatial frequencies.

36. (Original) The method of claim 30, wherein determining the mirror profile for each scan path comprises monitoring an orientation of the mirror surface with respect to the measurement axes during the scanning.

37. (Original) The method of claim 36, wherein determining the mirror profiles further comprises compensating the average slope of the mirror surface for the plurality of locations on the mirror surface for variations in the monitored orientation of the mirror surface.

38. (Original) The method of claim 30, wherein the scan paths are substantially orthogonal to the measurement axes.

39. (Original) The method of claim 30, wherein the mirror surface is scanned along one of the scan paths for a plurality of nominal rotation angles with respect to the measurement axes, and a mirror scan profile is determined for each of the nominal rotation angles.

40. (Previously Presented) A method comprising:

correcting measurements of a degree of freedom of a mirror relative to a first axis made using a first interferometer based on information that accounts for imperfections in interferometer optics of the first interferometer for different spatial frequencies, wherein the interferometer optics are configured to direct a beam to reflect from the mirror and contributions to the correction from the different spatial frequencies are weighted differently.

41. (Previously Presented) The method of claim 40, wherein a second interferometer monitors a degree of freedom of the mirror along a second axis parallel to and offset from the

first axis, the second interferometer comprising interferometer optics configured to direct a beam to reflect from the mirror.

42. (Previously Presented) The method of claim 41, wherein the information accounts for imperfections in the interferometer optics of the second interferometer.

43. (Previously Presented) The method of claim 41, contributions to the correction from different spatial frequency components are weighted to increase the sensitivity of the correction to spatial frequency components near K_d or harmonics of K_d, wherein K_d corresponds to the $2\pi/d$ where d is a separation between the first and second axes.

44. (Currently Amended) An apparatus comprising:

an interferometer configured to monitor a location, x_1, of a mirror surface along a first axis, the interferometer comprising interferometer optics configured to direct a beam to reflect from the mirror surface; and

an electronic controller coupled to the interferometer[[,]] and configured so that ~~wherein~~ during operation the electronic controller determines a location of the mirror surface along a third axis based on x_1, a location, x_2, of the mirror surface along a second axis and a correction term, ψ_3, calculated from predetermined information comprising information characterizing imperfections in the interferometer optics.

45. (Original) The apparatus of claim 44, further comprising a second interferometer configured to monitor x_2.

46. (Previously Presented) The apparatus of claim 45, wherein the second interferometer comprises interferometer optics configured to direct a beam to reflect from the mirror surface and the correction term, ψ_3, is calculated from predetermined information comprising information characterizing imperfections in the optics of the second interferometer.

47. (Original) The apparatus of claim 45, wherein the correction term, ψ_3, is calculated from predetermined information comprising information characterizing imperfections in the mirror surface.

48. (Original) The apparatus of claim 44, wherein the first axis is substantially parallel to the second measurement axis.

49. (Original) The apparatus of claim 48, wherein the third axis is substantially parallel to the first axes and the second axis is located between the first and third axes.

50. (Original) A lithography system for use in fabricating integrated circuits on a wafer, the system comprising:

a stage for supporting the wafer;

an illumination system for imaging spatially patterned radiation onto the wafer;

a positioning system for adjusting the position of the stage relative to the imaged radiation; and

the apparatus of claim 44 for monitoring the position of the wafer relative to the imaged radiation.

51. (Original) A lithography system for use in fabricating integrated circuits on a wafer, the system comprising:

a stage for supporting the wafer; and

an illumination system including a radiation source, a mask, a positioning system, a lens assembly, and the apparatus of claim 44,

wherein during operation the source directs radiation through the mask to produce spatially patterned radiation, the positioning system adjusts the position of the mask relative to the radiation from the source, the lens assembly images the spatially patterned radiation onto the

wafer, and the apparatus monitors the position of the mask relative to the radiation from the source.

52. (Original) A beam writing system for use in fabricating a lithography mask, the system comprising:

a source providing a write beam to pattern a substrate;

a stage supporting the substrate;

a beam directing assembly for delivering the write beam to the substrate;

a positioning system for positioning the stage and beam directing assembly relative one another; and

the apparatus of claim 44 for monitoring the position of the stage relative to the beam directing assembly.

53. (Previously Presented) A lithography method for use in fabricating integrated circuits on a wafer, the method comprising:

supporting the wafer on a moveable stage;

imaging spatially patterned radiation onto the wafer;

adjusting the position of the stage; and

monitoring the position of the stage using an interferometry system, wherein monitoring the position of the stage comprises determining the location of an alignment mark on the stage using the method of claim 1.

54. Cancelled

55. (Previously Presented) A lithography method for fabricating integrated circuits on a wafer comprising:

positioning a first component of a lithography system relative to a second component of a lithography system to expose the wafer to spatially patterned radiation; and

monitoring the position of the first component relative to the second component using an interferometry system,

wherein monitoring the position of the first component comprises determining the location of an alignment mark on the first component using the method of claim 1.

56. (Previously Presented) A method for fabricating integrated circuits, the method comprising:

applying a resist to a wafer;

forming a pattern of a mask in the resist by exposing the wafer to radiation using the lithography method of claim 53; and

producing an integrated circuit from the wafer.

57. Cancelled

58. (Previously Presented) A method for fabricating integrated circuits, the method comprising:

applying a resist to a wafer;

forming a pattern of a mask in the resist by exposing the wafer to radiation using the lithography method of claim 55; and

producing an integrated circuit from the wafer.

59-61. Cancelled

62. (Previously Presented) A lithography method for use in fabricating integrated circuits on a wafer, the method comprising:

supporting the wafer on a moveable stage;

imaging spatially patterned radiation onto the wafer;

adjusting the position of the stage; and

monitoring the position of the stage using an interferometry system,

wherein monitoring the position of the stage comprises correcting a measurement of a degree of freedom of a measurement object associated with the stage using the method of claim 17.

63. (Previously Presented) A lithography method for fabricating integrated circuits on a wafer comprising:

positioning a first component of a lithography system relative to a second component of a lithography system to expose the wafer to spatially patterned radiation; and

monitoring the position of the first component relative to the second component using an interferometry system,

wherein monitoring the position of the first component comprises correcting a measurement of a degree of freedom of a measurement object associated with the first component using the method of claim 17.

64. (Previously Presented) A method for fabricating a lithography mask, the method comprising:

directing a write beam to a substrate to pattern the substrate;

positioning the substrate relative to the write beam; and

monitoring the position of the substrate relative to the write beam using an interferometry system,

wherein monitoring the position of the substrate comprises correcting a measurement of a degree of freedom of a measurement object associated with the substrate using the method of claim 17.